Enhanced Access Penetration System (EAPS)

Technology Need:

The DOE could greatly benefit from an advanced Cone Penetrometer Technology (CPT) system that is capable of penetrating difficult subsurface strata. In recent years, great strides have been made in CPT, including the development of numerous instrumented probes and characterization tools. Despite these advancements, broad application of the technology has been limited by its inability to penetrate difficult geologic conditions. CPT, which relies on direct push force to drive the probe into the subsurface, has had great success in certain geologic conditions, such as sands and clays. The technology has had some success in gravel and cobbles, but has had limited success where large boulders or cemented layers exist. The unique capabilities of CPT could be of great benefit to characterization efforts in difficult geologies, currently considered to be inaccessible for CPT. At DOE's Hanford Site, carbon tetrachloride contamination exists in subsurface areas where cemented layers limit the access by CPT.

Technology Description:

The Enhanced Access Penetration System (EAPS) provides a suite of tools to be employed in response to the particular subsurface conditions encountered. The EAPS approach will use conventional push CPT whenever possible and temporarily resort to an alternate mode of penetration when conditions become impenetrable. The system will be based on the Wireline CPT, which allows tools and sensors to be interchanged without retracting the CPT rods from the ground. Laser drilling is also being developed for use with CPT as an innovative mode of penetration. Two new Wireline sampling tools will also be developed: a combination piezocone /soil-gas sampling probe, and a groundwater sampler with downhole purge capabilities.

The EAPS system will employ a graduated approach to overcome resistant strata encountered during a standard CPT push. The following alternate modes of penetration will be available: (1) use of the wireline soil sampler to remove resistant strata by coring (see Figure 1); (2) if this fails, drill by use of a small diameter (1-inch) Wireline drill to penetrate resistant strata; and (3) if this fails, remove wireline rods, and install casing tool and overburden drilling system (consisting of a 2-inch outer diameter down-the-hole drill that uses an air-driven percussion and hydraulically-driven rotation) to penetrate resistant strata. A thin-walled casing will be advanced behind the cutting bit of the overburden drilling system. After the difficult layer is penetrated, the Wireline CPT will be re-deployed through the casing left by the overburden drilling system. The casing left by the overburden drilling system will greatly reduce the frictional forces on the walls of the CPT rods allowing more force to be transferred to the tip.

The EAPS system will also incorporate a laser drilling system into the CPT/Overburden drilling system. Since laser drilling is still in the engineering concept stage, work will include designing and constructing a prototype system using a commercially available laser. Many technical challenges must be overcome including how to transport the laser power from the laser source to the subsurface

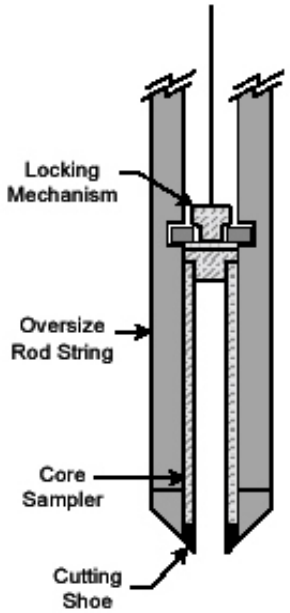

Figure 1: Wireline Core Sampler

and how laser cuttings and vapors will be transported to the surface.

The project also involves developing two new Wireline tools. The first tool will combine a piezocone tip with a soil gas sampler. This device will be capable of measuring tip stress and sleeve stress, while continuously collecting soil gas samples using an uphole vacuum pump. The second tool to be developed will be a Wireline groundwater sampler, which will be a downsized version of Applied Research Associates's (ARA's) ConeSipper™ sampler for conventional CPT. The groundwater sampler will be capable of purging the water sample downhole using helium or using air pressure to lift the sample to the surface.

Benefits

- Integration of Overburden drilling, and laser drilling with the Wireline CPT expands the use of CPT to difficult subsurface conditions, where CPT has not been applicable in past.
- Integrated Wireline piezocone/soil gas sampler will allow simultaneous geological profiling and screening for contamination.
- Wireline groundwater sampler will allow rapid collection and analysis of groundwater samples with near real time results.

Status and Accomplishments:

This project was started in September 2001. The project will be conducted in two phases, with the second phase being optional. Phase I includes: engineering design of the prototype equipment, building of prototype tools, factory/laboratory/field control tests, field tests at a site containing difficult subsurface conditions expected at DOE sites. Phase II will include full scale demonstration of the technology system at a selected DOE site with difficult subsurface conditions. Hanford's 200 West Area has been selected as the most likely location for the full-scale demonstration. Phase I testing is planned for an uncontaminated location of near the 200 West Area. The 200 West area contains both cemented materials at depths that are difficult to penetrate as well as an unknown distribution of carbon tetrachloride (CCl_4) that needs to be characterized.

Phase I design and fabrication has progressed well and ARA is scheduled to conduct Phase I field testing (off-site) in September 2002. On-site testing will follow at an uncontaminated location in or near the 200 West Area in October of 2002.

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Online Resources:

Office of Science and Technology, Technology Management System (TMS), Tech ID # 3156
http://ost.em.doe.gov/tms

The National Energy Technology Laboratory Internet address is http://www.netl.doe.gov

For additional information, please visit ARA's website at http://www.ara.com/